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AUTHOR Hart, Russ A.
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ABSTRACT

This exploratory study was conducted to investigate the potential interaction between the media attribute, horizontal screen placement, and a learner's cognitive aptitudes, fluid ability, and visualization. The primary hypothesis tested was that low-ability learners who are without well-developed assembly and control operations should perform better than high-ability students, who may find the visual strategies dysfunctional. The sample consisted of 252 undergraduate students (129 males, 123 females) enrolled in a multiple-section of a radio/television course. Treatments included three versions of a videotaped program that contained 10 simple concepts on sex role indicators. These concepts formed the basis for a visual stimuli set and a 22-item criterion test. Each stimulus was constructed in three versions for left, central, and right screen placement. Stepwise multiple linear regression was utilized to investigate the major hypotheses with the Group Embedded Figures Test, the Advanced Progressive Matrices Test (APM), APM subtest I and II, sex, age, and all possible interactions forming the predictor variables. The resulting equation revealed a highly significant F-ratio with 14 significant interactions accounting for 54% of the total variability. Alternative treatments promoted improved performance for many low-ability learners but actively diminished performance for many high-ability learners and vice versa. Findings of the study affirm the need for future research incorporating additional cognitive factors and alternative media attributes. A list of references and three data tables are provided. (Author/JB)

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THE EFFECT OF FLUID ABILITY, VISUAL ABILITY, AND VISUAL PLACEMENT WITHIN THE SCREEN ON A SIMPLE CONCEPT TASK

Russ A. Hart, Ph.D.
Instructional Telecommunication Center
California State University, Fresno
Fresno, California 93740-0050

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ABSTRACT

The purpose of this exploratory study was to examine the potential interactions between the media attribute, horizontal screen placement, and the cognitive aptitudes, fluid ability and visualization. Treatments included three versions of a videotaped program (left, central, or right) that were identical in every respect with the exception of ten visual stimuli. Stepwise, multiple linear regression was utilized to investigate the major hypotheses with the Group Embedded Figures Test, the Advanced Progressive Matrices Test (APM), APM subtests I and II, sex, age, and all possible interactions forming the predictor variables (N=252). The resulting equation revealed a highly significant F ratio with 14 significant interactions accounting for 54 percent of the total variability. Sex and age interactions were noted. Alternative treatments promoted improved performance for many low-ability learners but actively diminished performance for many high-ability learners and vice versa. The implications of this study have affirmed the need for future research incorporating additional cognitive factors and alternate media attributes.

THE EFFECT OF FLUID ABILITY, VISUAL ABILITY, AND VISUAL PLACEMENT WITHIN THE SCREEN ON A SIMPLE CONCEPT TASK

Recent discussion has surfaced in regard to the role of confounding effects in visually-based media research. Clark (1983) has asserted media do not influence learning under any conditions, but rather the instructional method employed is the crucial factor which fosters learning. A second rival hypothesis offered by Clark is that the increased attention paid by students to media may result in increased effort or persistence which yields achievement gains. Clark's argument is based upon the small, but positive, effects of student achievement found in meta-analysis (Cohen, Ebeling, & J. Kulik, 1981; C. Kulik, J. Kulik, & Cohen, 1980; J. Kulik, Bangert, & Williams, 1983; J. Kulik, C. Kulik, & Cohen, 1979). Clark (1984a, 1984b) has continued to insist that media attributes do not influence learning in unique ways. Further, Clark and Salomon (1985, p. 474) have advanced, "Any new technology is likely to teach better than its predecessors because it generally provides better prepared instructional materials and its novelty engages learners."

In a critique of Clark's article on learning from media, Petkovich and Tennyson (1984) have noted the lack of consideration for how the operation of the various components of the human information processing system affect learning. The need for consideration of processing demands has been

highlighted by research which has shown that individuals are likely to perform better in tasks in which they are suited by their cognitive style (Cronbach & Snow, 1977; Witkin, Moore, Goodenough, & Cox, 1977). Snow (1977) first postulated an intercorrelational paradigm of general ability (G) which incorporated human performance characteristics. Following the hierarchical model of ability organization interpreted by Cattell (1971) and extended by Horn (1976), Snow (1980) noted the relation of crystallized ability (G_c)--a constellation of measures of verbal knowledge, reading comprehension, and prior educational achievement--to learning outcomes is strongest in conventional instructional treatments. When such an instructional treatment is modified to reduce the need for conventional assembly and control processes, the relation of G_c to learn outcomes goes down. Fluid ability skills (G_f)--a constellation consisting of abstract and often nonverbal reasoning tests and some spatial and figural tests--should relate to learning outcomes under instructional conditions that are in some sense new, unlike those that the individual learner has faced in the past. Ability to apply previously crystallized learning skills (G_c) would not be relevant here, but ability to adapt to new kinds of learning or performance requirements (G_f) would be relevant. Snow (1980, p. 59) predicted, "...that as an instructional situation involves combinations of new technology (e.g., computerized instruction or television)...G_f should become important and G_c less important."

The distinction between "visualization" (G_v)--a constellation of figural and spatial relations tests in which the Group Embedded Figures Test (Witkin, Oltman, Raskin, & Karp, 1971) is frequently included--and G_f is often difficult to make, because they appear separable in multidimensional scaling but not in factor analysis. G_f and G_v are

separable at times, with some measures, and in some populations. Often, however, the close correlation between measures from each constellation has suggested that some individuals, or all individuals, sometimes use G_f processes to perform G_v tasks. Extensive reanalyses of figural and spatial test batteries, conducted by Lohman (1979), have suggested that spatial abilities do not fit neatly into a smoothly progressive hierarchial factor model, as verbal and numerical abilities seem to do. Again it may be individual differences in the novel assembly and control of spatial processing that underlie this relation, rather than a basic relation between fluid-analytic and spatial performance processes. Therefore, G_f tests that measure to a greater degree the kinds of assembly and control processes needed to organize on a short-term basis adaptive strategies for solving novel problems should be included in studies on interaction effects on learner and media attributes. In a radex topographic model of ability test intercorrelations, Snow and Lohman (1984) have shown Raven's (1962) Progressive Matrices is in the center of the map, and is to date one of the best measures of G or G_f.

This exploratory study was conducted to investigate the potential interaction between the media attribute (Salomon, 1979), "asymmetry of the screen" (Zettl, 1973), and the cognitive aptitudes, fluid ability and visualization. Metallinos (1979) has reviewed the theoretical basis of forces operating within the television screen and has noted that, with the exception of a few experiments with inconclusive results, the investigation of left, central and right placement within the frame has been largely ignored. While some research has been reported, none has shown any cogently significant differences (e.g., Avery & Tiemens, 1975; Fletcher, 1977, 1980; Herbener, Van Tubergen, & Witlow, 1979). Using a newscast

display format, Metallinos (1980) obtained significant differences for subjects describing the shape, perceiving the color, and recalling visual stimuli placed on the left side of the screen over the right; however, Niekamp (1981) reported that mean fixations of test stimuli measured by ocular photography favored the right. In regard to learning effects, Metallinos (1975) and Metallinos and Tiemens (1977) have reported no significant differences for the retention of news information. Nonetheless, Hart (1985) reported a predominant superiority for right placement on a simple concept task by older females. A meaningful difference was found for left placement over the central orientation as well, and interactions were noted. Field-independent females scored significantly higher than field-dependent females, and significant differences for and between field independence and field dependence occurred with right placement.

The purpose of this research was to ask whether, under the impact of different aptitudes, a particular frame position (left, central, or right) was warranted. The primary experimental hypothesis tested was that low-G learners who are without well developed assembly and control operations should perform more ably than high-G students who may find the visual strategies dysfunctional. Thus, the study compared a media attribute that differs in the degree to which it imposed common assemblies on students, seeking aptitude by treatment interactions in which the regression of learning on G is steeper in the treatment that is least imposing and shallower in the treatment that is the most imposing.

METHOD

Subjects

Students in a central California university enrolled in a multiple-section, "Radio-Television as Popular Culture" course were selected as subjects for the experiment. The sample consisted of 252 undergraduates ranging in age from 17 to 44 years (M=22.8, SD=4.0). Of the total group, 129 were male, and 123 were female. The ethnic composition was primarily Anglo American, with a representative minority of Hispanic-American, Afro-American, and Asian-American students.

Materials

Stimuli and Criterion Test. A nine-minute videotaped program and test instrument developed by Hart (1985) were employed. The program contained ten simple concepts on sex role indicators which formed the basis for a visual stimuli set and a 22-item criterion test (KR_{20}=.76). Each stimulus was constructed in three versions for left, central, and right screen placement. The three electronically edited experimental videotapes were identical with the exception of the embedded stimuli set.

Group Embedded Figures Test (GEFT). On the 18-item perceptual test (Spearman-Brown=.82), a field-independent person is able to better locate simple figures embedded in more complex designs than is a field-dependent individual (Witkin, Oltman, Raskin, & Karp, 1971). Field independence versus field dependence refers to a consistent mode of approaching the environment in analytical, as opposed to global, terms (Messick, 1977). The field-independent pole includes competence in analytical functioning, such as mathematical reasoning, verbal fluency, and spatial abilities, combined with an impersonal orientation and a tendency to have self-defined goals and reinforcements (Witkin, Moore, Oltman, Goodenough, Friedman, Owen, & Raskin, 1977). On the other hand, the field-dependent pole reflects correspondingly less competence in analytical skills combined with

greater social orientation and social skills as well as the need for externally defined goals and reinforcements (Goldstein & Blackman, 1978; Witkin, Moore, Goodenough, & Cox, 1977).

Repeated age and sex differences have been noted on the GEFT. Mean scores typically tend to be slightly, but significantly, higher for males. Consequently, women, on the average, are inclined to be more field dependent than men (Witkin & Goodenough, 1981). Field dependence is also a function of age. At some point after the age of 24, the process of increasing field dependence begins (Witkin, Oltman, Raskin, & Karp, 1971). Significant decreases in GEFT scoring across the life span have been reported with adequate reliability and validity (Panek, Barrett, Sterns, & Alexander, 1978; Panek, Funk, & Nelson, 1980).

Advanced Progressive Matrices (APM). Raven's test is a widely used set of analogical reasoning instruments which use geometric figures patterned after Spearman's wall chart (Burke, 1958). Set I consists of only 12 problems and is used to provide task training, similar to the first section of the GEFT. Set II is administered immediately thereafter and consists of 36 problems, arranged in ascending order of difficulty. Each of the 36 items consists of a stimulus array in which a 3 X 3 figural analogy is represented with a missing piece in the lower right portion of the array. A set of eight response alternatives is located beneath each stimulus array (Raven, 1962). Raven, Court, and Raven (1977) have reported a high retest reliability of 0.91. The test manual also noted a decline in scoring as age increases, particularly after the age of 30. Panek and Stoner (1980), have reported a significant decrease in performance for age groups but no significant sex differences.

Several factor analytic studies have been carried out with earlier forms of the APM. The results of these studies have prompted investigators to conclude that the tests constitute a measure of general intelligence ability or fluid G (MacArthur, 1960; Olsen & MacArthur, 1962; Spearman, 1939; Vernon, 1965a, 1965b). When the Progressive Matrices measures are factor analyzed along with other tests, the evidence is supportive of a high G loading and relatively trivial loadings on other factors. When the matrices are factor analyzed by themselves; however, evidence of multiple factors emerge (Carlson & Wiedel, 1979; Coreman & Budoff, 1974; Rimoldi, 1948; Wiedel & Carlson, 1976). Dillon, Pohlman, and Lohman (1981) found a two factor solution to yield the most interpretable structure. The two factors isolated in the factor analysis measured performance items in which a solution required (a) the addition and/or subtraction of elements or (b) the ability to perceive the progression of a pattern. The first subtest to measure the pattern progression factor was formed by combining items 2, 3, 4, 17, 26, and 36. Items 7, 9, 10, 11, 16, 21, 28, and 35 were used to form a second subtest to measure the addition/subtraction factor. These three researchers recommended subtest scores on the two factors be included in all future studies predicting behaviors.

Procedures

A total of nine randomly-assigned experimental sessions were conducted within a period of one week at the beginning of the fall semester. Each session followed the same format. As the volunteer subjects entered the room, they were encouraged by the experimenter to seat themselves in close proximity to a television receiver in order that (a) no one be farther away than 12 times the horizontal width of the screen, and (b) a line of vision of not more than 45 degrees from the center line axis perpendicular to the

picture tube be maintained as a maximum viewing angle (Chapman, 1960). An initial overview of the session was provided with a short description of the instruments to be completed and of the videotaped program to be viewed. The GEFT and APM were administered, respectively, according to their test manuals (Witkin, Oltman, Raskin, & Karp, 1971; Raven, 1962). Subsequent to the completion of the cognitive indices, one of the three visual treatments was administered and immediately followed by the posttest. Subjects were not informed of the intended purpose of the experiment until a short report was presented later in the semester by the participating course instructors.

RESULTS

Group Equivalence

Because the study employed nine experimental sessions, three for each of the three treatments, equivalence of the three combined groups was an important question to investigate prior to testing for the experimental hypothesis. A three level, one-way analysis of variance was used in analyzing the data between the groups for each of the following subject background and cognitive variables: age, F (2,249) = 1.56, M = 22.8; GEFT, F (2,249) = .45, M = 11.48; APM, F (2,249) = 1.31, M = 17.13. Differences between sexual composition were analyzed using the independent samples Chi-Square Test, $\chi^2(2, N=252) = 2.06$. The results showed no significant differences between the groups on any of the variables at the .05 level of significance.

To determine if the subjects had dissimilar life-history experiences which might have altered the equivalence of the groups, two multiple choice questions on the posttest were analyzed using the Kruskal-Wallis one-way analysis of variance for ranks. No significant differences were noted

between the groups at the .05 level for subjects having read sex role material, χ^2 (2,N=252) = .91, or having had a recent encounter with a sex typing situation, χ^2 (2,N=252) = .52. The mean for both questions was between the last two responses, "over two years" and "no encounter."

Regression Analysis

Multiple regression analysis has become an increasingly popular statistical technique (Serlin & Levin, 1985). Cronbach and Snow (1977) have noted that linear regression equations are most useful in exploring aptitude-treatment-interaction designs, because the technique provides a simple method for establishing a functional relationship among variables. For example, in an experiment with several treatments (a categorical variable), aptitudes of subjects (a continuous variable) may be used to study the interaction between the variables in their effect on a dependent variable.

$$Y = a + b_1X_1 + b_2X_2 + b_3X_1X_2 \ . \ . \ .$$

In this study, the parameters of the multiple linear regression equation for testing the major hypotheses were computed in a stepwise manner. The independent or predictor variables were visual placement, GEFT, APM, APM Subtest I, APM Subtest II, sex, age, and all possible interactions. Table 1 presents the intercorrelations among the main variables.

Insert Table 1 about here.

Two dummy variables were created for visual placement (K-1 levels), left placement and right placement, with membership being assigned 1 and nonmembership being assigned 0. As a nominal variable, sex was treated

similarly with males being assigned 1 and females being assigned 0 (Cohen & Cohen, 1983). The dependent measure was the 22-item posttest. The Biomedical Computer Program (BMDP2R) was utilized to facilitate the analysis (Dixon, 1983).

Following the examination of residuals on the initial attempt, the relationship was found to be a nonlinear "S" shape. The linearizable curve, the logistic response function, was chosen to represent the date: $P'_i = \ln (P_i/1-P_i)$, where P was the posttest expressed as a percentage. The logistic model has been used extensively in biological work. Besides medicine and pharmacology, the logistic model has been used in learning theory, the study of consumer behavior (response to advertising) and market promotion studies (Chatterjee & Price, 1977).

Applying the weighted-least-squares (WLS) method as is required on the transformed logit variable, heteroscedastic residuals were observed on APM Subtest I and APM Subtest II. Heteroscedasticity is resolved by applying variations of WLS (Draper & Smith, 1981). Estimates of the regression coefficient were carried out using WLS with weights $W_i = 1/\sigma^2_{u_i}$. Thus, the nonconstant residual variance was accounted for by case weights associated with the variance of the logistic response function, APM Subtest I, and APM Subtest II. Table 2 presents a summary of the final regression analysis, and Table 3 presents the estimated regression coefficients.

Insert Table 2 and Table 3 about here.

The stepwise multiple regression analysis yielded 14 significant variables:

$$Y' = -1.2842 - .1243X_1 + .0046X_2 + .3187X_3 + .0145X_4 + 1.4898X_5 + .0149X_6 + .0053X_7 + .3145X_8 - .1238X_9 + .00013X_{10} - .00020X_{11} + .0052X_{12} - .0033X_{13} - .00015X_{14}$$

Y' is the predicted score; X_1 is the interaction of GEFT and sex; X_2 is the interaction of GEFT and age; X_3 is the interaction of APM subtest I and right screen placement; X_4 is the interaction of sex and age; X_5 is the interaction of sex and right screen placement; X_6 is the interaction of APM, APM subtest I, and left screen placement, X_7 is the interaction of APM, APM subtest II, and sex; X_8 is the interaction of APM subtest II, sex and right screen placement; X_9 is the interaction of sex, age, and right screen placement; X_{10} is the interaction of GEFT, APM, sex, and age; X_{11} is the interaction of GEFT, APM, APM subtest I, APM subtest II, and right screen placement; X_{12} is the interaction of GEFT, APM subtest I, APM subtest II, sex, and left screen placement; X_{13} is the interaction of APM subtest I, APM subtest II, sex, age, and left screen placement; and X_{14} is the interaction of GEFT, APM subtest I, APM subtest II, age, and left screen placement. In all, five first-order interactions, four second-order interactions, one third-order interaction, and four fourth-order interactions were entered into the equation. The resulting multiple correlation was .72 with a standard error of estimate of .40. An F-test of the multiple correlation revealed $F(14,237) = 181.17$ which was significant beyond the .001 level.

The method of variable coding will aid in the interpretation of the interactions. The test of a coefficient is tantamount to testing the difference between the group assigned 1 in the vector with which the coefficient is associated and the mean of the group assigned 0s in all the

vectors. The tests of the coefficient are therefore relevant when one wishes to test, in turn, the differences between the means of each group assigned 1 in a given vector and that of a group assigned 0s in all vectors. Dummy coding is not restricted to situations in which there are several treatment groups and a control group. They can be used to code any categorical variable, for example, sex (Pedhazur, 1982).

Two other points are worth mentioning. First, recall that product vectors represent the interaction terms. Interaction vectors are created by multiplying the vectors representing the categorical variable by the vector for the continuous variable. When more than one continuous variable is used, the vectors representing the categorical variable are multiplied in turn by each of the vectors for the continuous variables. This process is continued until all possible combinations are produced. Second, the standard regression coefficient may be thought of as the regression coefficients that would have been obtained if the various predictor variables were equal to one another in terms of means and standard deviation. The predictor variable that has the largest standard regression coefficient, disregarding whether the coefficient is positive or negative, is the best predictor; conversely, a small standard regression coefficient indicates that the corresponding predictor variable is not contributing to successful prediction as much as the other predictor variables (Cohen & Cohen, 1983; Draper & Smith, 1981).

Applying the above, the examination of the interactions will prove most informative. Since sex was assigned by designating 1 for males and 0 for females, the X_1 variable, GEFT by sex, indicated GEFT scores for male subjects had a significantly negative impact upon the prediction equation ($p<.001$). On the other hand, the sex by age interaction, X_4, indicated

older male subjects had a slightly higher predicted score ($p<.05$). The interaction of sex and right screen placement, X_5, also indicated males profited from participation in this treatment group ($p<.05$); however, the higher-order interaction of sex by age by right screen placement, X_9, indicated older male subjects were dehabilitated by participation in the very same group ($p<.001$). The second-order interaction X_9 and the first-order interaction X_1 had the two largest standard coefficients, -2.19 and -1.49, respectively. Thus, they contributed greatly to the prediction equation.

The variable sex interacted in five other conditions. The APM, APM subtest II, and sex interaction, X_7, had a small positive contribution to the prediction equation ($p<.05$). Male subjects who scored well on the APM and APM subtest II performed slightly better as a result. Sex also interacted with APM subtest II and right screen placement, X_8, indicating males with high APM subtest II scores benefited from placement in that treatment condition ($p<.01$). Variable X_{10}, the interaction of GEFT, APM, sex, and age, indicated older males who possessed high GEFT and APM scores had slightly larger predicted scores ($p<.01$). The higher-order interaction X_{12}, GEFT by APM subtest I by APM subtest II by sex by left screen placement, evidenced high scoring males on the cognitive variables profited from placement in that treatment condition ($p<.001$), but the fourth-order interaction X_{13}, APM subtest I by APM subtest II by sex by age by left screen placement, indicated older males who performed well only on the APM subtest I and APM II were dehabilitated by placement in that very same group ($p<.001$). Variables X_{12} and X_{13} had almost equal but opposite standard coefficients, .84 and -.89, respectively.

Of the five remaining interaction variables, four included treatment conditions, and one included a first-order interaction with a cognitive index. Unlike variable X_1, GEFT by sex, variable X_2, GEFT by age, revealed GEFT scores had a small positive impact upon the prediction equation when considering the subjects' age ($p<.001$). In regard to the treatment conditions, variable X_3, the APM subtest I by right screen placement interaction, indicated that subjects with high APM subtest I scores profited from participation in that treatment ($p<.001$), and the interaction also had a heavy positive impact upon the prediction equation with a standard coefficient of 1.12. On the other hand, variable X_{11} disclosed APM subtest I and right screen placement interacted at a higher level with GEFT, APM, and APM subtest II, producing a slightly dehabilitating effect in the very same treatment for high scoring subjects on all the cognitive variables ($p<.001$). When considering left screen placement, the interaction of APM, APM subtest I, and left screen placement in variable X_6 had a slightly positive effect on the prediction equation with high scoring subjects on those measures being aided by the placement condition ($p<.001$). Again, the higher-order interaction of GEFT by APM subtest I by APM subtest II by age by left screen placement, X_{14}, resulted in a slightly diminishing effect for the prediction equation ($p<.001$). Yet on the variable, those older, high scoring subjects on GEFT, APM subtest I, and APM subtest II were only slightly dehabilitated by that same treatment.

Among the 14 significant predictors, 11 contained cognitive indices in interaction terms. All the cognitive tests and subtests were represented. Nine of the variables also contained screen placement treatments. Of these, five contained right screen placement and four contained left screen

placement. When considering those variables with standard coefficients of approximately one or greater which would have contributed the most to the prediction equation, right screen placement was contained in three of the four interactions: X_3, X_5, and X_9. Of the four major predictors, cognitive indices contributed only to two interactions: X_1, GEFT by sex, and X_3, APM subtest by right screen placement.

DISCUSSION

Before commencing with a discussion of the resulting data, a circumspection should be observed. In interpreting multiple-regression factors from an aptitude-interaction standpoint, third-order and higher interactions must be interpreted cautiously, if at all, without well grounded theory (Cronbach & Snow, 1977). Unreliability may have especially powerful effects in a multivariate study. Index error, sampling error, and sample size may have produced anomalies. Thus, this study should be considered exploratory in nature.

Performance on a simple concept task presented via three screen placements was found to possess a significant aptitude-treatment prediction equation, although age differences and sex differences were noted. The relationship between variables may be interpreted as substantial support for a cognitive aptitude theory of learning from instruction (Cronbach & Snow, 1977; Witkin, Moore, Goodenough, & Cox, 1977) and the media attribute theory (Salomon, 1979). This rationale is particularly warranted when considering that alternative treatments promoted improved performance for many low-G learners but actually diminished the performance of many high-G learners. In other words, the treatment that was mathemagenic (gave birth to learning) for one kind of individual appeared to be mathemathanic (give death to learning) for another kind of individual and vice versa (Snow,

1977; Snow & Lohman, 1984). To say it still another way, different kinds of inaptitudes showed through from the inner environments of low-G and high-G learners, depending on the nature of the outer environment.

Results confirmed Hart's (1985) findings of a general superiority for older females (M=40.0 years) when right screen placement was utilized to facilitate simple concept learning. Older males were severly dehabilitated under the right screen treatment in the present study, despite that males, as a whole, performed better under right screen placement in the lower-order interaction. Niekamp (1981) had noted, by ocular photography, mean fixations favoring the right for a small group of subjects who were predominately males. In addition, field-independent females were at a distinct performance advantage, as they had been in the earlier Hart study, confirming that modeling cue attendance favored only the highly field-independent learners (Salomon, 1979; Witkin, Moore, Oltman, Goodenough, Friedman, Owen, & Raskin, 1977). Contrary to expectations for reported sex differences (Witkin & Goodenough, 1981), field-independent males were dehabilitated over all the visual treatments; however, the lower social orientation of field-independent males may have interacted with the sex-role subject matter to produce this effect (Goldstein & Blackmen, 1978; Witkin, Moore, Goodenough, & Cox, 1977). Older male performance was found to increase generally when fluid ability skills evidenced on the APM were called upon to direct spatial visualization abilities exhibited on the GEFT (Snow, 1980). This performance advantage partially supported the age-related differences noted on the indices (Witkin, Oltman, Raskin, & Karp, 1971; Panek, Barrett, Sterns, & Alexander, 1978; Panek, Funk, & Nelson, 1980; Panek & Stoner, 1980).

In regard to the APM and its subtests, right screen placement was found to increase simple concept acquisition for those high ability subjects who possessed increased pattern addition/pattern subtraction skills (APM subtest I). Individuals performing well on the factor are expected to successfully ferret out figures from more complex forms, to identify figures placed in the periphery of vision, and to recognize words or figures with portions erased (Dillion, Pohlman, & Lohman, 1981). When the high-ability G_f skills were combined with the first subtest, the left screen placement interacted for subject performance. Perhaps the flexible processing control of G_f directed the application of what may be considered a G_v skill in the solution of the visual task (Lohman, 1979; Snow & Lohman, 1984), since normal eye scanning patterns are initiated from the left in western cultures (see, for example, the eye scanning research reviewed by Niekamp, 1981). In other words, the solution of a visual task for concept acquisition required the intervention of higher-order skills in the left orientation, but the solution was readily apparent in the right screen orientation to those individuals who possessed increased levels of the pattern addition/pattern subtraction visualization skills.

Right screen placement was also found to increase simple concept acquisition for those high-ability males who possessed pattern progression skills (APM subtest II). Individuals exhibiting high performance levels on this factor are expected to demonstrate a high degree of success in estimating projected movement and assessed consequences, as well as in performing various mental rotations (Dillon, Pohlman, & Lohman, 1981). Where the assembly and control processing of G_f interacted with the second subtest, males were at a performance advantage, irrespective of screen placement. Apparently, the G_v skill of pattern progression was

activated by right screen placement in males who possessed the ability at increased levels; however, when this same skill was called into play by the higher-order G_f function, screen position made no difference in concept attainment. In other words, those males operating at higher-order strategic processing levels were able to obtain salient cues despite the visual orientation (Snow, 1977, 1980).

When G_v skills interacted, some interesting effects were observed. Males who possessed high levels of field independence, pattern addition/pattern subtraction, and pattern progression were facilitated to concept attainment over females through the left screen orientation; however, older individuals with these same G_v skills suffered a diminishment in performance under the same placement. Note that older males with only two of the three G_v measures, pattern addition/pattern subtraction and pattern progression, were dehabilitated under the left screen orientation. Perhaps some form of perceptual pretraining has been ingrained in high-ability mature individuals who automatically activate G_v skills in search of information in center of the screen when viewing television. Tentative support for this interpretation is provided by another fourth-order interaction. When the fluid-analytic G_f skill was called upon by individuals to direct the G_v skills, a diminution in concept attainment occurred under the right screen treatment over central placement. Thus, as strategic processing was called into play, the central placement proved superior over the right orientation, indicating at least an initial preference for this position. Once again, the reader is reminded this interpretation of the high-order interactions is offered charily until a better grounded theory of cognitive aptitudes is developed.

In summary, the media attribute (Salmon, 1979), "asymmetry of the screen" (Zettl, 1973), was found to interact with the cognitive aptitudes, fluid ability and visualization, under 14 conditions on a simple concept task. Sex differences and age differences were noted. Yet visual placement helped many lower ability learners by giving them component assemblies they could not produce on their own. On the other hand, the highest aptitude students were hindered by the visual treatments because the intervention interfered with the strategies they normally used. The importance of aptitude-treatment hypotheses and methodology is thus as clear for a research on learning strategies in mediated instruction as it is for education generally (Petkovich & Tennyson, 1984). While the method, organization, and novelty of instruction are important factors (Clark, 1983, 1984a, 1984b; Clark & Salomon, 1985), a cognitive aptitude theory of learning from instruction will account for the involvement of assembly and control processes that marshal, adapt, and monitor the operation of response components assembled into a performance program for a given task (Snow & Lohman, 1984).

This exploratory study has indicated further research is warranted with media attributes when considering the impact of different learner aptitudes. Only 52 percent of the total variability of visual placement was explained by the variation in the included cognitive aptitudes. Other cognitive factors will have to be considered for a better explanation of visual placement. Further, Zettl (1973) had identified other media coding systems within the frame: main direction of horizontal and vertical orientations, attraction of symbol mass, figure-ground relationships, psychological closure, vectors or directional lines, and movement. The relationship between the processing demands of these media attributes and

the processing capacity of the learner must be also investigated. Without question, this research approach places the emphasis upon the single most important element in the educational process--the human information processing system.

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TABLE 1

INTERCORRELATIONS AMONG THE MAIN VARIABLES

Variables	1	2	3	4	5	6	7
1. Posttest	-	.32	.26	-.02	.17	-.22	.16
2. GEFT		-	.12*	-.08	-.09	-.10	-.06
3. APM			-	.31	.40	-.19	.07
4. APM Subtest I				-	.08	.11	-.06
5. APM Subtest II					-	.03	-.02
6. Sex						-	.21
7. Age							-

TABLE 2

SUMMARY OF REGRESSION ANALYSIS

Source of Variation	SS	df	MS	F
Regression	41.49	14	2.96	18.17***
Error	38.66	237	.16	
N = 252	R^2 = .52			s = .40

***p <.001

TABLE 3

ESTIMATED REGRESSION COEFFICIENTS

Variable	Coefficient	SE	Standard Coefficient	F
GEFT X Sex	-.1243	.0180	-1.49	47.87***
GEFT X Age	.0046	.0005	.88	103.11***
APM Subtest I X Right Screen Placement	.3187	.0367	1.12	75.27***
Sex X Age	.0145	.0076	.33	3.93*
Sex X Right Screen Placement	1.4898	.6750	.99	4.87*
APM X APM Subtest I X Left Screen Placement	.0149	.0029	.81	26.87***
APM X APM Subtest II X Sex	.0053	.0026	.35	4.04*
APM Subtest II X Sex X Right Screen Placement	.3145	.1140	.91	7.61**
Sex X Age X Right Screen Placement	-.1238	.0201	-2.19	38.10***
GEFT X APM X Sex X Age	.00013	.00005	.69	8.38**
GEFT X APM X APM Subtest I X APM Subtest II X Right Screen Placement	-.00020	.00003	-.78	45.39***
GEFT X APM Subtest I X APM Subtest II X Sex X Left Screen Placement	.0052	.0012	.84	20.05***
APM Subtest I X APM Subtest II X Sex X Age X Left Screen Placement	-.0033	.0006	-.89	27.61***
GEFT X APM Subtest I X APM Subtest II X Age X Left Screen Placement	-.00015	.00004	-.62	14.91***
CONSTANT	-1.2842			

*p < .05
**p< .01
***p< .001